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VERIFICATION OF A TRANSLATION

Assistant Commissioner for Patents
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2. The document for which the attached English translation is being submitted is a patent application on an invention entitled MULTI-FREQUENCY ANTENNA DUPLEXER.

3. That I am knowledgeable in the English language and in the language of JP2000-171538, and I believe the attached English translation to be a true and complete translation of JP2000-171538.

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Date: 26 December, 2003

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[Title of the Invention] Multi-frequency antenna duplexer

[What is claimed is]

[Claim 1] A multi-frequency antenna duplexer comprising a plurality of antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, wherein the plurality of antenna duplexers are mounted in a same package, and the passing band of each antenna duplexer is different.

[Claim 2] The multi-frequency antenna duplexer of claim 1, further comprising a first piezoelectric substrate forming a plurality of surface acoustic wave filters for transmission, a second piezoelectric substrate forming a plurality of surface acoustic wave filters for reception, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, all being mounted in the same package.

[Claim 3] The multi-frequency antenna duplexer of claim 1, wherein the surface acoustic wave filter for transmission and surface acoustic wave filter for reception for composing each one of the antenna duplexers having transmission bands different in frequency are composed on one piezoelectric substrate individually, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception is mounted in the same package.

[Claim 4] The multi-frequency antenna duplexer of claim 1, wherein the phase shift substrate is formed in the package.

[Claim 5] A multi-frequency antenna duplexer comprising a plurality

of antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, wherein the plurality of antenna duplexers are mounted in a same package, and the passing band of each antenna duplexer is different.

[Claim 6] A multi-frequency antenna duplexer comprising a plurality of antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, wherein and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception is mounted in a same package.

[Claim 7] The multi-frequency antenna duplexer of claim 6, wherein the phase shift substrate is formed in the package.

[Claim 8] A multi-frequency antenna duplexer comprising two antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, wherein the two antenna duplexers and a branching filter are mounted in a same package, each antenna terminal is connected by using the branching filter in the two antenna duplexers, and the package has only one antenna output terminal.

[Claim 9] The multi-frequency antenna duplexer of claim 8, further comprising a first piezoelectric substrate forming two surface acoustic wave filters for transmission, a second piezoelectric substrate forming two surface

acoustic wave filters for reception, a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, all being mounted, together with the branching filter, in the same package.

[Claim 10] The multi-frequency antenna duplexer of claim 8, wherein the surface acoustic wave filter for transmission and surface acoustic wave filter for reception having transmission bands different in frequency are composed on one piezoelectric substrate individually, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, and the branching filter are mounted in the same package.

[Claim 11] The multi-frequency antenna duplexer of claim 8, wherein the phase shift substrate and branching filter are formed in the package.

[Claim 12] A multi-frequency antenna duplexer comprising two antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, wherein the two antenna duplexers and a branching filter are mounted in a same package, each antenna terminal is connected by using the branching filter in the two antenna duplexers, and the package has only one antenna output terminal.

[Claim 13] The multi-frequency antenna duplexer of claim 12, being a multi-frequency antenna duplexer comprising two antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band

of each other, wherein and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, and the branching filter are mounted in the same package.

[Claim 14] The multi-frequency antenna duplexer of claim 13, wherein the phase shift substrate and branching filter are formed in the package.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to an antenna duplexer used in a mobile communication appliance.

[0002]

[Prior Art]

A conventional antenna duplexer is generally formed of coaxial resonators or distributed constant type resonators, and the number of stages of resonators and their shape are determined in order to obtain desired electric characteristics such as passing band width and attenuation amount.

[0003]

A multi-frequency antenna duplexer is formed of a plurality of conventional antenna duplexers, and includes, for example, a multi-frequency antenna duplexer comprising transmitter filters 25a, 25b and receiver filters 26a, 26b composed of coaxial resonators as shown in Fig. 13, and a multi-frequency antenna duplexer of switching type time division multiples access (TDMA) system as shown in Fig. 14 in which the passing frequency is divided by a branching filter 23, and transmission and reception

are changed over by single pole double throw (SPDT) switches 27a, 27b.

[0004]

[Problems to be Solved by the Invention]

What matters in this multi-frequency antenna duplexer is that the filter characteristic depends largely on the shape of the resonator, which makes it difficult to reduce in size. In particular, in the code division multiplex access (CDMA) system incapable of switching, the required number of resonators increases, and the shape is increased in size. For example, when the multi-frequency antenna duplexer largely different in passing band frequency such as 800 MHz and 1.8 GHz is composed of distributed constant type resonators, the electric characteristic of substrate materials and others used in the distributed constant type resonators depends on the frequency, and it is hard to optimize the electric characteristic.

[0005]

It is hence an object of the invention to reduce the size of such multi-frequency antenna duplexer.

[0006]

[Means to Solve the Problems]

To solve the problem, the multi-frequency antenna duplexer of the invention is a multi-frequency antenna duplexer comprising a plurality of antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, in which the plurality of antenna duplexers are mounted in a same package, and the passing band of each antenna duplexer is different.

[0007]

Therefore, the multi-frequency antenna duplexer can be reduced in size.

[0008]

The multi-frequency antenna duplexer further comprises a first piezoelectric substrate forming a plurality of surface acoustic wave filters for transmission, a second piezoelectric substrate forming a plurality of surface acoustic wave filters for reception, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, all being mounted in the same package, and therefore signal leak between transmission and reception can be suppressed, the isolation is assured, and the size can be reduced.

[0009]

Preferably, in the multi-frequency antenna duplexer, the surface acoustic wave filter for transmission and surface acoustic wave filter for reception for composing each one of the antenna duplexers having transmission bands different in frequency are composed on one piezoelectric substrate individually, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception is mounted in the same package, and therefore the plurality of antenna duplexers having passing bands largely different in frequency can be reduced in size without deteriorating their characteristics.

[0010]

In the multi-frequency antenna duplexer, in the antenna duplexers for two frequencies corresponding to two passing band frequencies, only one

antenna output terminal may be required by connecting the antenna duplexer and the branching filter mounted in the same package to the antenna terminal for each antenna duplexer, and hence a multi-frequency antenna duplexer of a smaller size may be realized.

[0011]

By forming the phase shift substrate and branching filter used in the multi-frequency antenna duplexer in a package, a multi-frequency antenna duplexer of a smaller size may be realized.

[0012]

In the multi-frequency antenna duplexer, the surface acoustic wave filter and bulk wave filter can be used selectively depending on the passing band frequency or desired filter characteristic, so that a multi-frequency antenna duplexer of higher performance may be realized in a small size.

[0013]

[Description of the Preferred Embodiments]

The invention as set forth in claim 1 is a multi-frequency antenna duplexer comprising a plurality of antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, in which the plurality of antenna duplexers are mounted in a same package, and the passing band of each antenna duplexer is different, and therefore the multi-frequency antenna duplexer can be reduced in size.

[0014]

The invention as set forth in claim 2 relates to the multi-frequency antenna duplexer of claim 1, further comprising a first piezoelectric substrate forming a plurality of surface acoustic wave filters for

transmission, a second piezoelectric substrate forming a plurality of surface acoustic wave filters for reception, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, all being mounted in the same package, and therefore signal leak between transmission and reception can be suppressed, the isolation is assured, and the size can be reduced.

[0015]

The invention as set forth in claim 3 relates to the multi-frequency antenna duplexer of claim 1, in which the surface acoustic wave filter for transmission and surface acoustic wave filter for reception for composing each one of the antenna duplexers having transmission bands different in frequency are composed on one piezoelectric substrate individually, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception is mounted in the same package, and therefore the plurality of antenna duplexers having passing bands largely different in frequency can be reduced in size without deteriorating their characteristics.

[0016]

The invention as set forth in claim 4 relates to the multi-frequency antenna duplexer of claim 1, in which the phase shift substrate is formed in the package, and therefore the phase shift substrate and the surface acoustic wave filters for transmission and reception can be disposed in a solid configuration, and the size may be further reduced.

[0017]

The invention as set forth in claim 5 is a multi-frequency antenna duplexer comprising a plurality of antenna duplexers, each including two

filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, in which the plurality of antenna duplexers are mounted in a same package, and the passing band of each antenna duplexer is different, and therefore the two types of filters can be used selectively depending on the passing band frequency and filter characteristic, so that the size can be reduced while maintaining the performance.

[0018]

The invention as set forth in claim 6 relates to the multi-frequency antenna duplexer of claim 5, further comprising a plurality of antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, in which and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception is mounted in a same package, and therefore the size can be reduced by including the phase circuit.

[0019]

The invention as set forth in claim 7 relates to the multi-frequency antenna duplexer of claim 6, in which the phase shift substrate is formed in the package, and therefore the phase shift substrate and the filters for transmission and reception can be disposed in a solid configuration, and the size may be further reduced.

[0020]

The invention as set forth in claim 8 is a multi-frequency antenna

duplexer comprising two antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, in which the two antenna duplexers and a branching filter are mounted in a same package, each antenna terminal is connected by using the branching filter in the two antenna duplexers, and the package has only one antenna output terminal, and therefore it can be connected to the antenna terminal without using external parts, and the size can be reduced.

[0021]

The invention as set forth in claim 9 relates to the multi-frequency antenna duplexer of claim 8, further comprising a first piezoelectric substrate forming two surface acoustic wave filters for transmission, a second piezoelectric substrate forming two surface acoustic wave filters for reception, a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, all being mounted, together with the branching filter, in the same package, and therefore signal leak between transmission and reception can be suppressed, the isolation is assured, and the size can be reduced.

[0022]

The invention as set forth in claim 10 relates to the multi-frequency antenna duplexer of claim 8, in which the surface acoustic wave filter for transmission and surface acoustic wave filter for reception having transmission bands different in frequency are composed on one piezoelectric substrate individually, and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, and the branching filter are mounted in

the same package, and therefore the plurality of antenna duplexers having passing bands largely different in frequency can be reduced in size without deteriorating their characteristics.

[0023]

The invention as set forth in claim 11 relates to the multi-frequency antenna duplexer of claim 8, in which the phase shift substrate and branching filter are formed in the package, and therefore the phase shift substrate, branching filter and the surface acoustic wave filters for transmission and reception can be disposed in a solid configuration, and the size may be further reduced.

[0024]

The invention as set forth in claim 12 is a multi-frequency antenna duplexer comprising two antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, in which the two antenna duplexers and a branching filter are mounted in a same package, each antenna terminal is connected by using the branching filter in the two antenna duplexers, and the package has only one antenna output terminal, and therefore it can be connected to the antenna terminal without using external parts, and the size can be reduced.

[0025]

The invention as set forth in claim 13 relates to the multi-frequency antenna duplexer of claim 12, being a multi-frequency antenna duplexer comprising two antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at

least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, in which and a phase shift substrate having a function of rotating the phase of each transmission band at least in each surface acoustic wave filter for reception, and the branching filter are mounted in the same package, and therefore the size can be reduced by including the phase circuit.

[0026]

The invention as set forth in claim 14 relates to the multi-frequency antenna duplexer of claim 13, in which the phase shift substrate and branching filter are formed in the package, and therefore the phase shift substrate, branching filter and the surface acoustic wave filters for transmission and reception can be disposed in a solid configuration, and the size may be further reduced.

[0027]

Preferred embodiments of the invention are described below by referring to Fig. 1 to Fig. 12.

[0028]

In Fig. 1 to Fig. 12, same constituent elements are identified with same reference numerals.

[0029]

(Preferred Embodiment 1)

Fig. 1 is a perspective view of configuration of multi-frequency antenna duplexer in a first preferred embodiment of the invention, Fig. 2 is its circuit diagram, and Fig. 3 is its frequency characteristic diagram.

[0030]

The multi-frequency antenna duplexer in Fig. 1 is composed of surface

acoustic wave filters for transmission 11a, 11b and surface acoustic wave filters for reception 12a, 12b formed on a piezoelectric substrate, phase shift substrates 13a, 13b, and a package 14, the outside of the package 14 includes antenna terminals 15a, 15b, transmitter terminals 16a, 16b, receiver terminals 17a, 17b, and a grounding terminal (not shown), and the inside includes connection pads 18a to 18f, and the connection pads 18a, 18b are connected to the transmitter terminals 16a, 16b, the connection pads 18c, 18d are connected to the receiver terminals 17a, 17b, and the connection pads 18e, 18f are connected to the antenna terminals 15a, 15b, respectively, in the package.

[0031]

The surface acoustic wave filters for transmission 11a, 11b, surface acoustic wave filters for reception 12a, 12b, and phase shift substrates 13a, 13b have two connection terminals individually, and one terminal of the surface acoustic wave filter for transmission 11a is connected to the connection pad 18a by a bonding wire 19b, one terminal of the surface acoustic wave filter for transmission 11b is connected to the connection pad 18b by a bonding wire 19a, other terminals of the surface acoustic wave filters for transmission 11a, 11b are connected to the connection pads 18e, 18f by bonding wires 19c, 19e, one terminal of the surface acoustic wave filter for reception 12a is connected to the connection pad 18c by a bonding wire 19i, one terminal of the surface acoustic wave filter for reception 12b is connected to the connection pad 18d by a bonding wire 19j, other terminals of the surface acoustic wave filters for reception 12a, 12b are connected to the one-side terminals of the phase shift substrates 13a, 13b by bonding wires 19g, 19h, and other terminals of the phase shift substrates 13a, 13b are connected

to the connection pads 18e, 18f by bonding wires 19d, 19f.

[0032]

Fig. 2 is a circuit diagram of the multi-frequency antenna duplexer in Fig. 1.

[0033]

Fig. 3 is a frequency characteristic diagram of the multi-frequency antenna duplexer in Fig. 1, in which the antenna duplexer composed of the surface acoustic wave filter for transmission 11a, surface acoustic wave filter for reception 12a, and phase shift substrate 13a is expressed by passing characteristics 31a, 32a having passing bands 33a, 34a and attenuating bands 35a, 36a, respectively, and the antenna duplexer composed of the surface acoustic wave filter for transmission 11b, surface acoustic wave filter for reception 12b, and phase shift substrate 13b is expressed by passing characteristics 31b, 32b having passing bands 33b, 34b and attenuating bands 35b, 36b, respectively.

[0034]

In this configuration, since the surface acoustic wave filters for transmission 11a, 11b, surface acoustic wave filters for reception 12a, 12b, and phase shift substrates 13a, 13b can be mounted in a same package 14, the size of the multi-frequency antenna duplexer can be reduced.

[0035]

When the passing frequency bands of the plurality of antenna duplexers are close to each other, by composing as shown in Fig. 4, in which the surface acoustic wave filters for transmission 11a, 11b are replaced by a surface acoustic wave filter for transmission 11c formed on a same piezoelectric substrate, the surface acoustic wave filters for reception 12a,

12b are replaced by a surface acoustic wave filter for reception 12c formed on a same piezoelectric substrate, and the phase shift substrates 13a, 13b replaced by a phase shift substrate 13c, the mounting surface in the package is saved and the size may be further reduced. This is because the thickness of the metal thin film on the piezoelectric substrate when forming the surface acoustic wave filters is required to be about 8 to 10% of the value standardized by the frequency, and the characteristics are excellent, and therefore plural surface acoustic wave filters can be formed on the piezoelectric substrate, and can be fabricated in a same process.

[0036]

Fig. 5 is a circuit diagram of multi-frequency antenna duplexer in Fig. 4, and Fig. 6 is an application example of multi-frequency antenna duplexer in Fig. 4 in a cellphone system.

[0037]

Fig. 6 shows an example of CPS (personal computer system) of the United States, in which the passing bands 33a, 33b of the surface acoustic wave filter for transmission are 1850 MHz to 1885 MHz, and 1885 MHz to 1910 MHz, and the passing bands 34a, 34b of the surface acoustic wave filter for reception are 1930 MHz to 1965 MHz, and 1965 MHz to 1990 MHz.

[0038]

Contrary to the case in Fig. 4 to Fig. 6, if the passing frequency bands of the plural antenna duplexers are largely different, since the thickness of the metal thin film on the piezoelectric substrate is largely different between the plural antenna duplexers, it is difficult to optimize. Accordingly, as shown in Fig. 7, by forming the surface acoustic wave filter for transmission 11a and surface acoustic wave filter for reception 12a of one antenna duplexer on

the same piezoelectric substrate 20a, and forming another on a different piezoelectric substrate 20b, the size can be reduced without deteriorating the characteristic of the antenna duplexer.

[0039]

Fig. 8 is a circuit diagram of the multi-frequency antenna duplexer in Fig. 7, and Fig. 9 is an application example of multi-frequency antenna duplexer in Fig. 7 in a cellphone system.

[0040]

Fig. 9 shows an example of dual band system of European GSM (global system for mobile communications) / DCS (digital cellular system), in which the passing bands 33a, 33b of the surface acoustic wave filter for transmission are 880 MHz to 915 MHz, and 1710 MHz to 1785 MHz, and the passing bands 34a, 34b of the surface acoustic wave filter for reception are 925 MHz to 960 MHz, and 1805 MHz to 1880 MHz.

[0041]

Accordingly, to realize a multi-frequency antenna duplexer of smaller size, as shown in Fig. 10, the phase shift substrates 13a, 13b may be installed in the inner layer of the package 14. Herein, one-side terminals of the surface acoustic wave filters for reception 12a, 12b are connected to connection pads 18g, 18h in the package 14 by way of bonding wires 19g, 19h, the connection pads 18g, 18h and one-side ends of phase lines 21a, 21b are connected by way of through-holes 22a, 22c, and the connection pads 18e, 18f and other ends of phase lines 21a, 21b are connected by way of through-holes 22b, 22d.

[0042]

In this configuration, the circuit diagram is same as Fig. 5, and since

the phase lines are incorporated in the inner layer in the package, the mounting area of the phase shift substrate in the package is saved, and thereby a multi-frequency antenna duplexer of smaller size may be realized.

[0043]

This preferred embodiment refers to a multi-frequency antenna duplexer having two passing bands, but it is the same if having three or more bands. Mounting of surface acoustic wave filters and phase shift substrates in the package is not limited to wiring bonding, but the size may be further reduced by flip-chip mounting.

[0044]

(Preferred Embodiment 2)

Fig. 11 is a perspective view of configuration of multi-frequency antenna duplexer in a second preferred embodiment of the invention, and Fig. 12 is its circuit diagram

[0045]

The multi-frequency antenna duplexer in Fig. 11 has same reference numerals provided in the same constituent elements in Fig. 7 explained in preferred embodiment 1. Herein, a branching filter 23 is mounted in the package 14, and one terminal of the surface acoustic wave filter for transmission 11a and one terminal of the branching filter 23 are connected to the phase shift substrate 13a of one antenna duplexer by way of wire bondings 19c, 19d, and one terminal of the surface acoustic wave filter for transmission 11b and other terminal of the branching filter 23 are connected to the phase shift substrate 13b of other antenna duplexer by way of wire bondings 19e, 19f, and the circuit diagram is as shown in Fig. 12.

[0046]

In this configuration, by contrast to the dual band system such as GSM/DCS explained in preferred embodiment 1, only one antenna terminal is enough, an it can be connected to the antenna without connecting external terminal, so that the device can be reduced in size ultimately.

[0047]

The size can be further reduced by incorporating the branching filter 23 in the inner layer of the package 14 such as phase lines 21a, 21b in Fig. 10.

[0048]

In preferred embodiments 1 and 2, if the passing band frequency is extremely low, or depending on the required filter characteristics, a bulk wave filter may be used aside from the surface acoustic wave filter. In the bulk wave filter, the piezoelectric substrate itself generates mechanical vibrations to work as resonator, and its mounting is different from the case of the surface acoustic wave filter, and the piezoelectric substrate must be formed as a hollow structure for mounting, but it is easy by changing the shape of the package.

[0049]

[Advantage of the Invention]

As described herein, according to the invention, the multi-frequency antenna duplexer comprises a plurality of antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, in which the plurality of antenna duplexers are mounted in a same package, and the passing band of each antenna duplexer is different, and therefore the multi-frequency antenna duplexer can be reduced in size.

[0050]

The multi-frequency antenna duplexer comprises two antenna duplexers, each including two filters for transmission and reception having passing bands different in frequency, at least one filter thereof being a bulk wave filter and others being surface acoustic wave filters, for attenuating the passing band of each other, in which the two antenna duplexers and a branching filter are mounted in a same package, each antenna terminal is connected by using the branching filter in the two antenna duplexers, and the package has only one antenna output terminal, and therefore the multi-frequency antenna duplexer can be reduced in size, and at the same time it can be connected to the antenna terminal without adding external elements, and the device size can be also reduced.

[0051]

By incorporating the phase shift substrate and branching filter in the package, the mounting area of elements in the package can be reduced, and a multi-frequency antenna duplexer of smaller size can be realized.

[0052]

In the filters for transmission and reception, by using a bulk wave filter depending on the passing band frequency or desired filter characteristic, a multi-frequency antenna duplexer of higher performance and smaller size can be realized.

[0053]

In this constitution, the multi-frequency antenna duplexer can be easily reduced in size.

[Brief Description of the Drawings]

Fig. 1 is a perspective view of configuration of multi-frequency antenna duplexer in a first preferred embodiment of the invention.

Fig. 2 is a circuit diagram of the multi-frequency antenna duplexer.

Fig. 3 is a frequency characteristic diagram of the multi-frequency antenna duplexer.

Fig. 4 is a perspective view of configuration of other example of multi-frequency antenna duplexer in the first preferred embodiment of the invention.

Fig. 5 is a circuit diagram of the multi-frequency antenna duplexer.

Fig. 6 is a frequency characteristic diagram of the multi-frequency antenna duplexer.

Fig. 7 is a perspective view of configuration of a different example of multi-frequency antenna duplexer in the first preferred embodiment of the invention.

Fig. 8 is a circuit diagram of the multi-frequency antenna duplexer.

Fig. 9 is an application example of the multi-frequency antenna duplexer.

Fig. 10 is a perspective view of configuration of the multi-frequency antenna duplexer incorporating the phase shift substrate in the first preferred embodiment of the invention.

Fig. 11 is a perspective view of configuration of multi-frequency antenna duplexer in a second preferred embodiment of the invention.

Fig. 12 is a circuit diagram of the multi-frequency antenna duplexer.

Fig. 13 is a perspective view of configuration of multi-frequency antenna duplexer in a prior art.

Fig. 14 is a circuit diagram of a multi-frequency antenna duplexer in a prior art composed of switches.

[Description of the Reference Numerals]

11a to 11c Surface acoustic wave filter for transmission

12a to 12c Surface acoustic wave filter for reception

13a to 13d Phase shift substrate

14 Package

15a to 15c Antenna terminal

16a, 16b Transmitter terminal

17a, 17b Receiver terminal

18a to 18h Connection pad

19a to 19k Bonding wire

20a, 20b Piezoelectric substrate

21a, 21b Phase line incorporated in the inner layer of package

22a to 22d Through-hole

23 Branching filter

24 Substrate

25a, 25b Coaxial filter for transmission

26a, 26b Coaxial filter for reception

27a, 27b SPDT switch

[Name of the Document] Abstract

[Abstract]

[Object] To present a multi-frequency antenna duplexer of small size in an antenna duplexer applicable to plural frequencies by using surface acoustic wave filters.

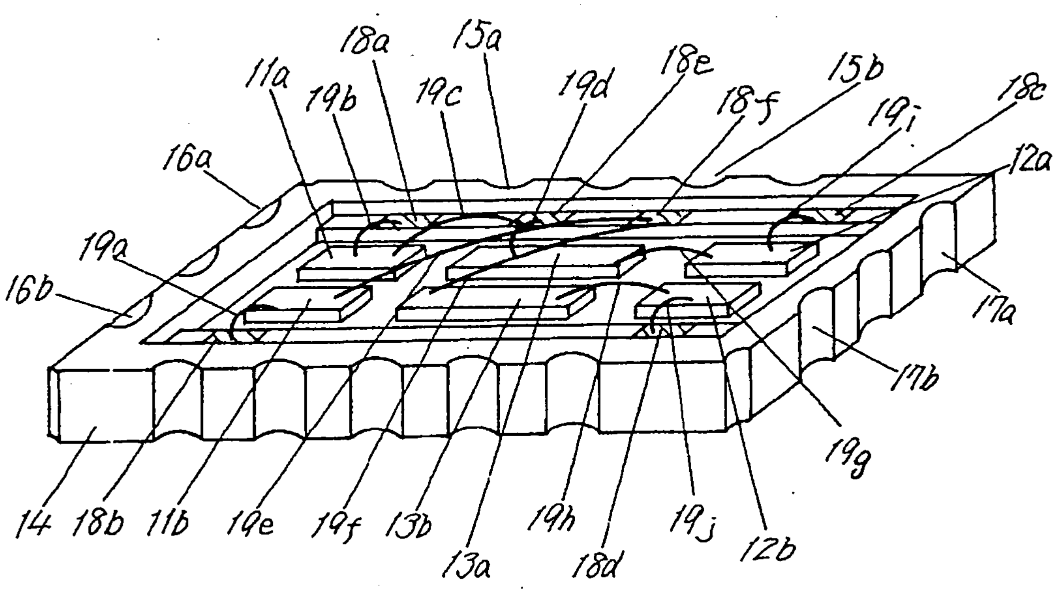
[Means to Solve the Problems] A multi-frequency antenna duplexer using a plurality of antenna duplexers, each including two surface acoustic wave filters for transmission and reception having passing bands different in frequency, for attenuating the passing band of each other, and by mounting surface acoustic wave filters for transmission 11a, 11b, surface acoustic wave filters for reception 12a, 12b, and phase shift substrates 13a, 13b in a same package 14, the multi-frequency antenna duplexer can be reduced in size.

[Selected Drawing] Fig. 1

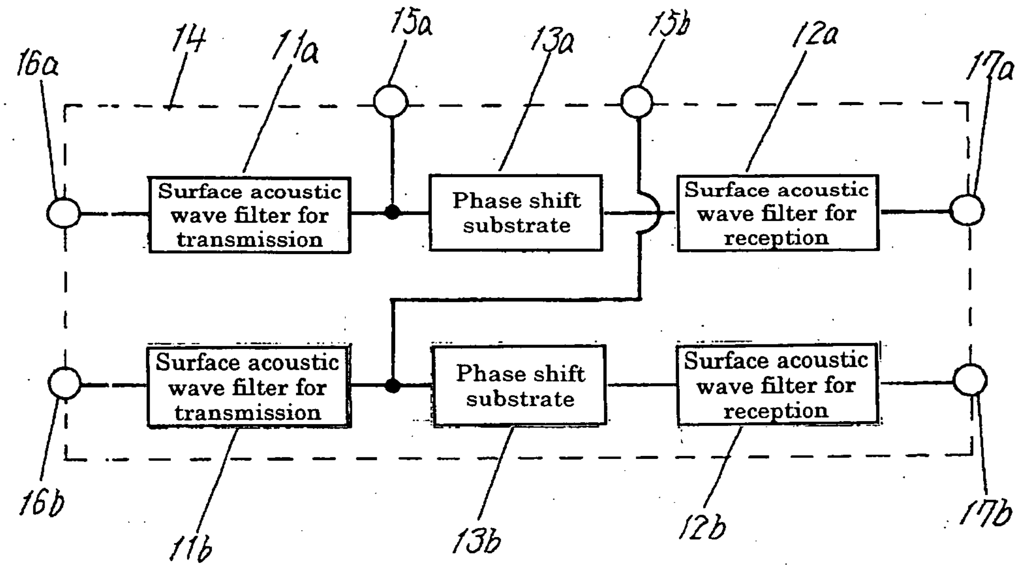
[Name of the Document] Drawing

[Fig. 1]

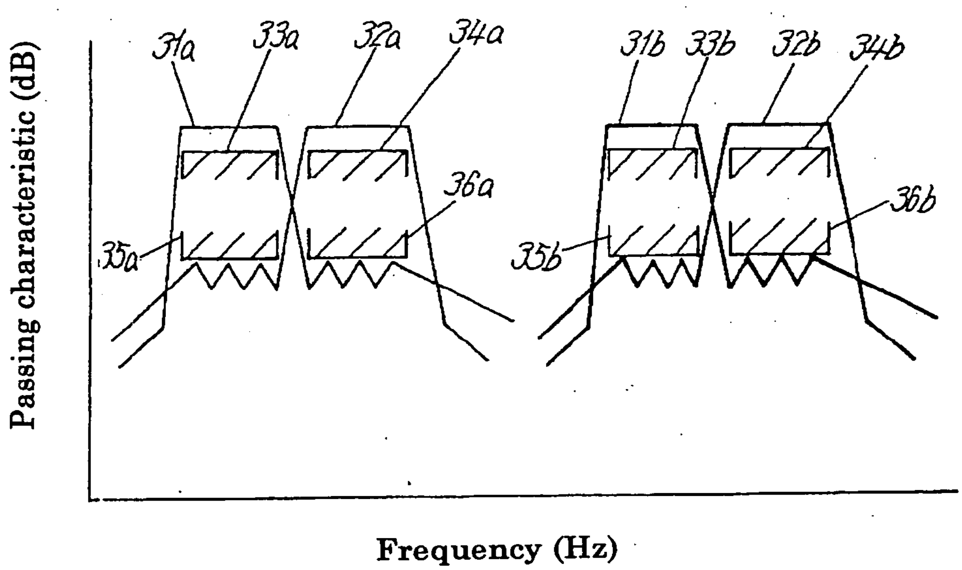
11a, 11b	Surface acoustic wave filter for transmission
12a, 12b	Surface acoustic wave filter for reception
13a, 13b	Phase shift substrate
14	Package
15a, 15b	Antenna terminal
16a, 16b	Transmitter terminal
17a, 17b	Receiver terminal
18a to 18f	Connection pad
19a to 19j	Bonding wire



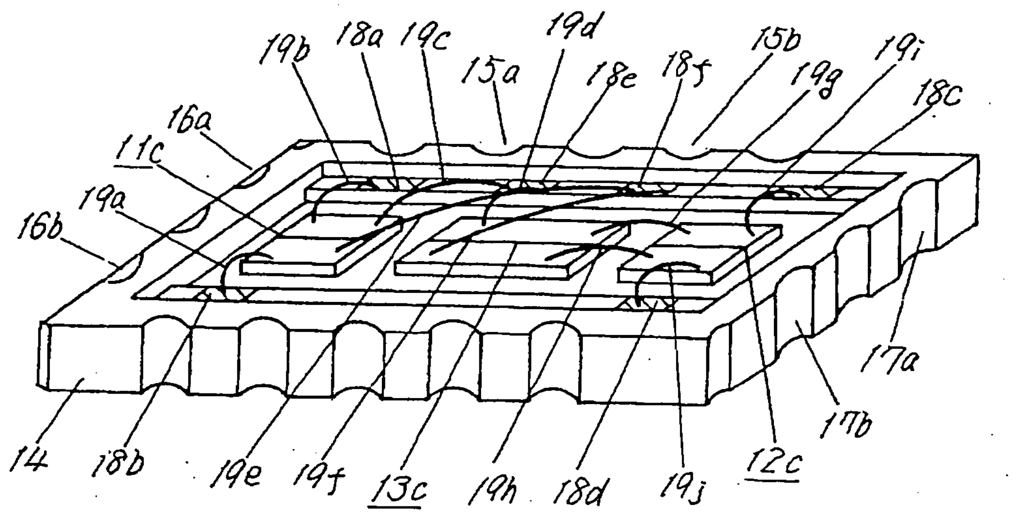
[Fig. 2]


14
11a
15a
13a
15b
12a
16a
17a
Surface acoustic wave filter for transmission
Phase shift substrate
Surface acoustic wave filter for reception
Surface acoustic wave filter for transmission
Phase shift substrate
Surface acoustic wave filter for reception
16b
11b
13b
12b
17b

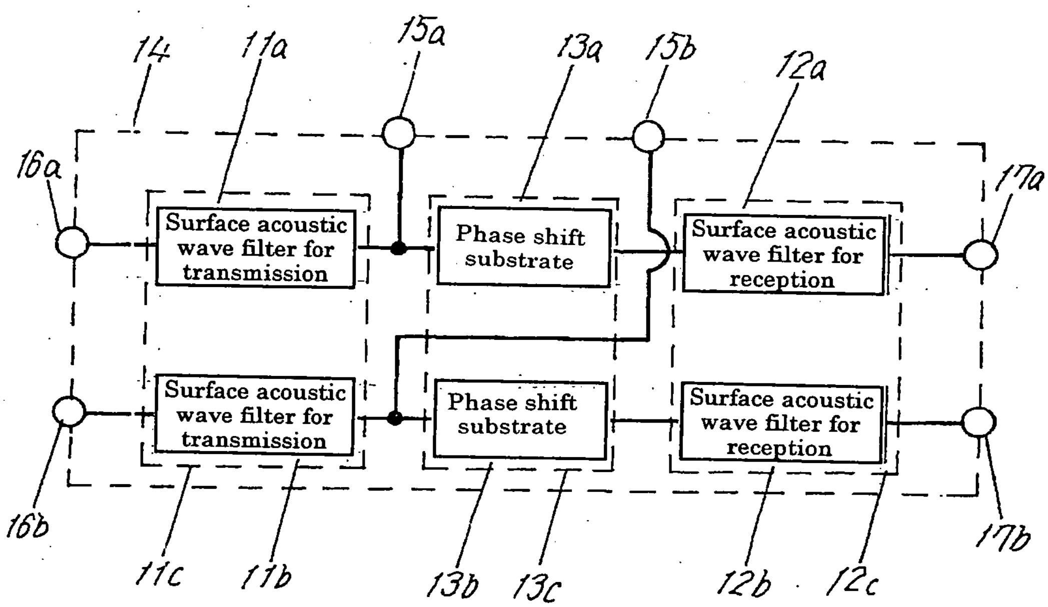
[Fig. 3]


31a
33a
32a
34a
31b
33b
32b
34b
36a
36b
35a
35b
Passing characteristic (dB)
Frequency (Hz)

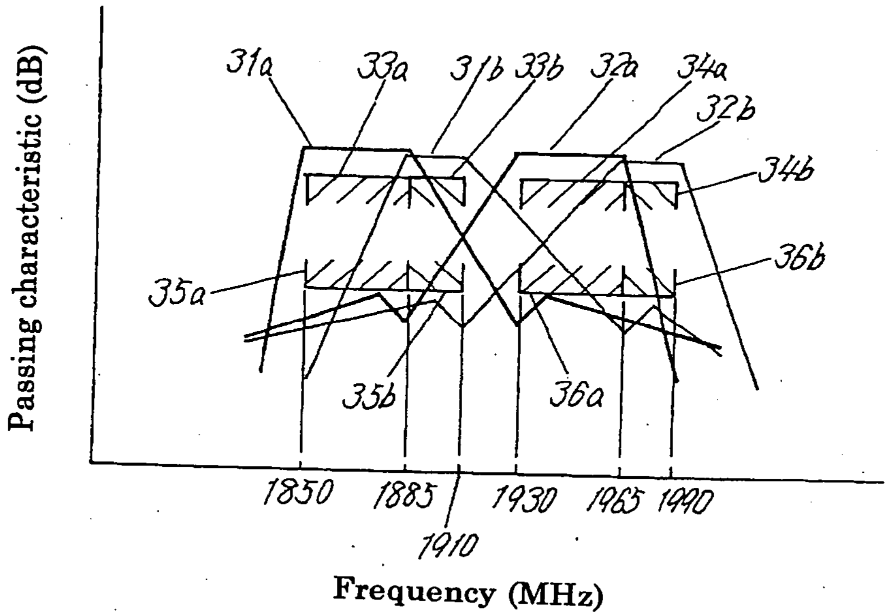
[Fig.4]


19b
18a
19c
19d
15a
18e
18f
15b
19g
19i
18c
16a
11c
19a
16b
17a
17b
14
18b
19e
19f
13c
19h
18d
19j
12c

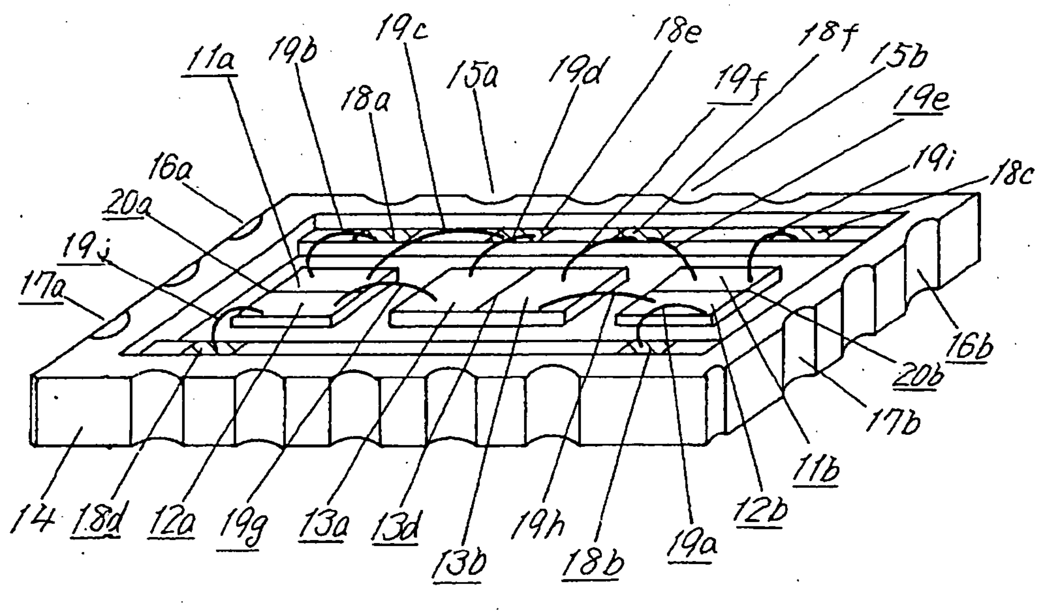
[Fig. 5]


14
11a
15a
13a
15b
12a
16a
17a
Surface acoustic wave filter for transmission
Phase shift substrate
Surface acoustic wave filter for reception
Surface acoustic wave filter for transmission
Phase shift substrate
Surface acoustic wave filter for reception
16b
17b
11c
11b
13b
13c
12b
12c

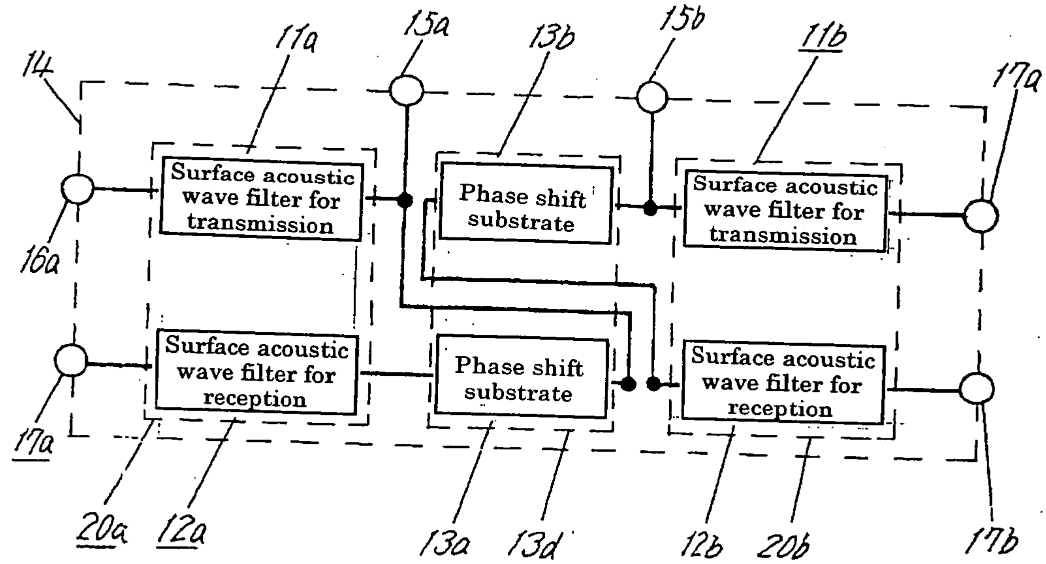
[Fig. 6]


Passing characteristic (dB)
31a
33a
31b
33b
32a
34a
32b
34b
35a
36b
35b
36a
1850
1885
1910
1930
1965
1990
Frequency (MHz)

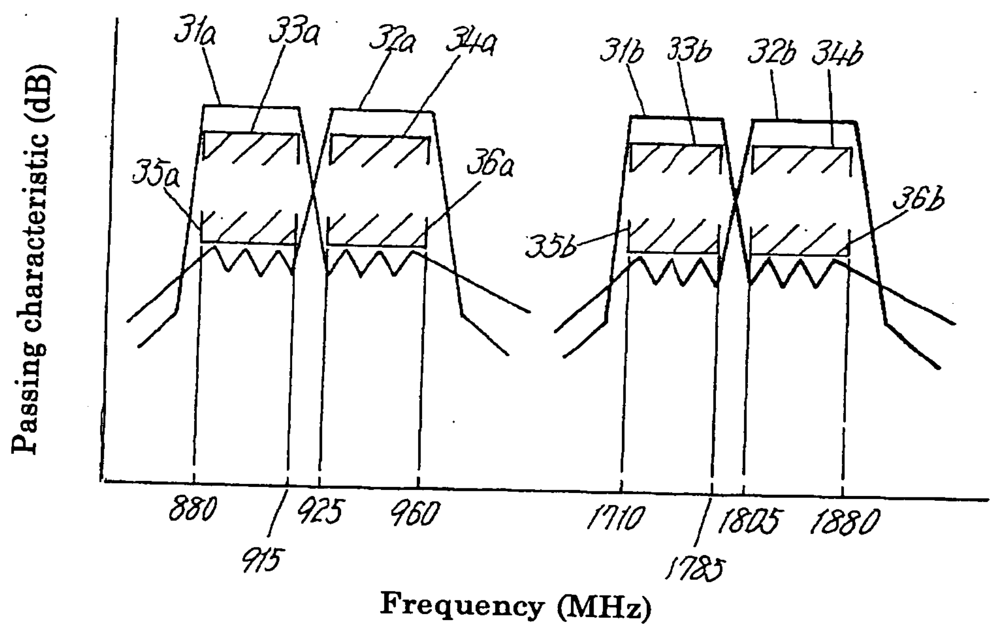
[Fig.7]


11a
19b
19c
18a
15a
19d
18e
18f
15b
19f
19e
16a
20a
19i
18c
19j
17a
16b
20b
17b
11b
14
18d
12a
19g
13a
13d
13b
19h
18b
19a
12b

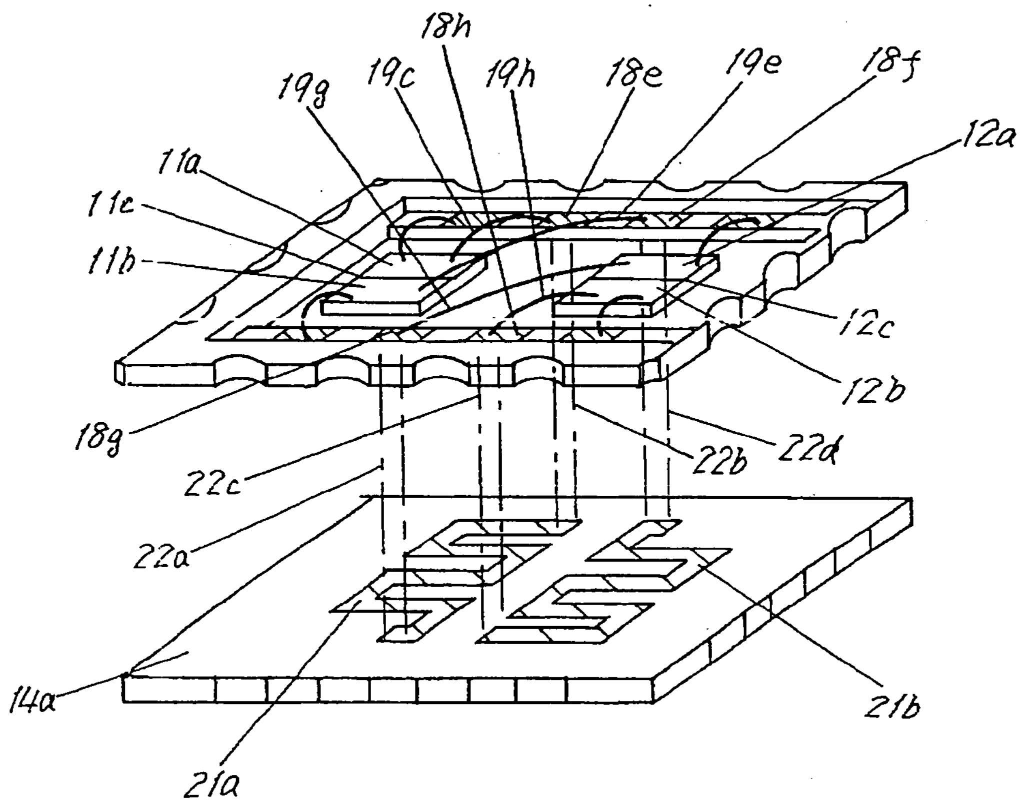
[Fig. 8]


14
11a
15a
13b
15b
11b
17a
Surface acoustic wave filter for transmission
Phase shift substrate
Surface acoustic wave filter for transmission
16a
Surface acoustic wave filter for reception
Phase shift substrate
Surface acoustic wave filter for reception
17a
20a
12a
13a
13d
12b
20b
17b

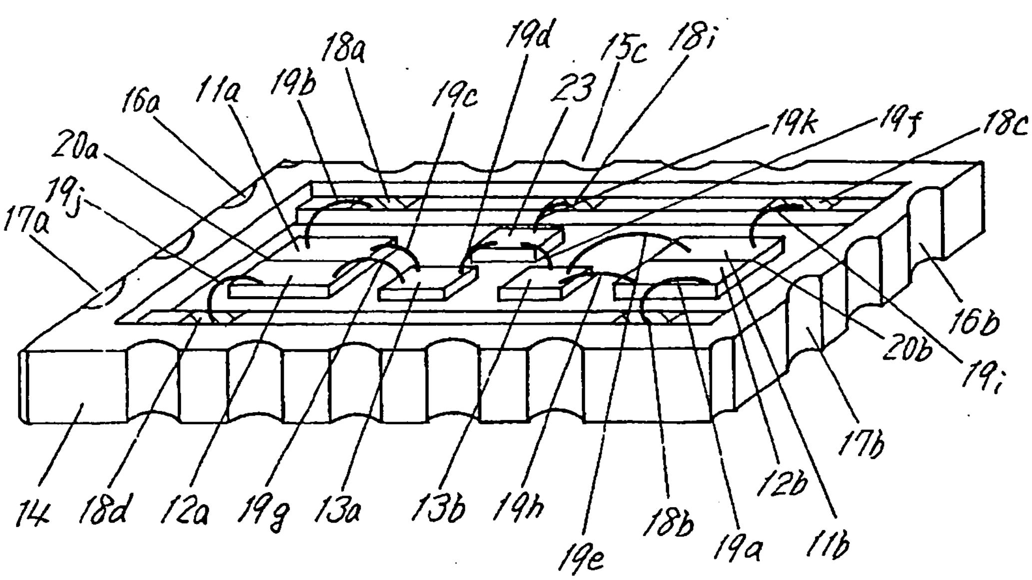
[Fig. 9]


Passing characteristic (dB)
31a
33a
32a
34a
31b
33b
32b
34b
35a
36a
35b
36b
880
915
925
960
1710
1785
1805
1880
Frequency (MHz)

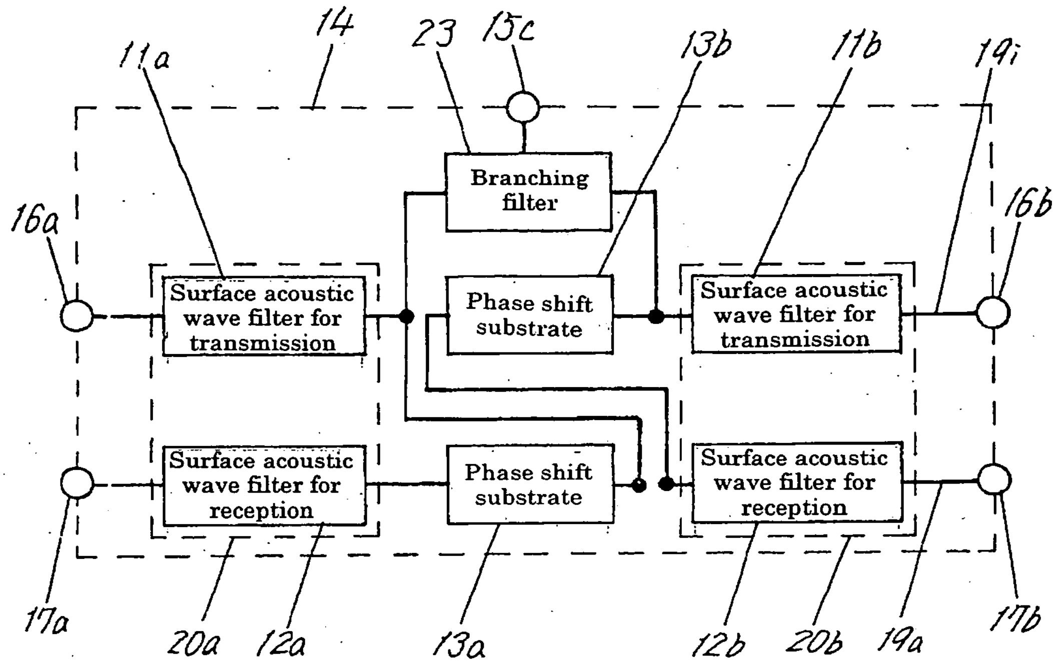
[Fig.10]


18h
19g
19c
19h
18e
19e
18f
12a
11a
11c
11b
12c
12b
18g
22c
22b
22d
22a
14a
21b
21a

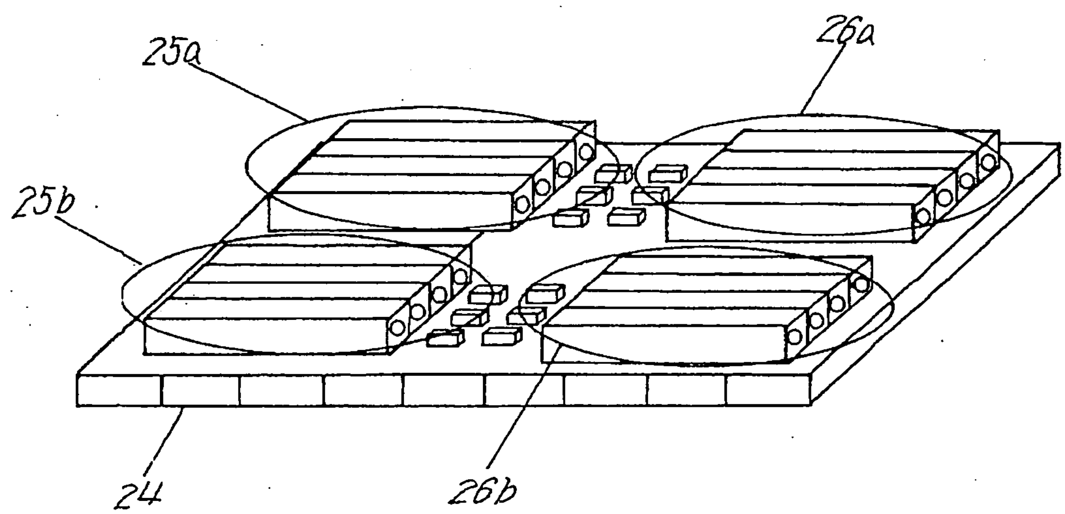
[Fig.11]


19d
15c
18i
18a
16a
11a
19b
19c
23
19k
19f
18c
20a
19j
17a
16b
20b
19i
17b
14
18d
12a
19g
13a
13b
19h
19e
18b
19a
11b
12b

[Fig. 12]


14
23
15c
11a
13b
11b
19i
16a
16b
Branching filter
Surface acoustic wave filter for transmission
Phase shift substrate
Surface acoustic wave filter for transmission
Surface acoustic wave filter for reception
Phase shift substrate
Surface acoustic wave filter for reception
17a
20a
12a
13a
12b
20b
19a
17b

[Fig.13]


25a
26a
25b
24
26b

[Fig. 14]